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Effects of Chemical Additive X-78 on Ginning and Processing Performance and Cotton Quality

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PREFACE

This report is based on two ginning-spinning experiments conducted in 1966 and one in 1967 concerning the use of a liquid additive applied to cotton during ginning. Progress reports, based on the 1966 experiments, were presented before audiences made up principally of spinners at Pine Mountain, Ga., and ginners at Memphis, Tenn. These two progress reports contained minor differences due to methods of data handling, but they were in full agreement regarding conclusions drawn from the experiments. These data are reported herein, and again they may differ slightly from the progress reports. The 1967 experiment was designed and conducted to expand and strengthen the conclusions drawn from the 1966 experiments. Results of the 1967 experiment have not been reported.

CONTENTS

	Page
Texas experiment, 1966	1
Experimental procedure	1
Results and discussion	2
Mississippi experiment, 1966	3
Experimental procedure	3
Results and discussion	4
Mississippi experiment, 1967	6
Experimental procedure	6
Results and discussion	7
Summary	10

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Effects of Chemical Additive X-78 on Ginning and Processing Performance and Cotton Quality

BY A. CLYDE GRIFFIN, PRESTON H. LAFERNEY, and HENRY H. PERKINS, JR.[1]

Applying chemical additives to cotton during mill processing or finishing to give particular processing benefits or to impart particular characteristics is well established. Various groups and individuals have sought to improve the harvesting, ginning, or marketing of cotton by adding to the raw cotton at harvesting or ginning such conditioning agents as kerosene, water, hexadecyl alcohol, surface active agents, and certain textile mineral oils. Manufacturers of textile goods have generally discouraged the use of chemical additives at the harvesting and ginning stages because they often interfere with chemical treatments applied during mill processing and fabric finishing.

In 1966 it was expedient for the U.S. Department of Agriculture to conduct field and laboratory experiments to evaluate an additive known as Protect-O-Coat Formula X–78 when it is added to raw cotton during ginning. Objectives of these experiments were to determine the effects of the additive on gin processing and on fiber, spinning, and dyeing qualities of cotton. The manufacturer recommended applying the chemical to the cotton at the seed-cotton distributor as an air-blown mist at about 55 gallons to 700 bales of cotton. This is equivalent to adding X–78 to cotton at about 0.15 percent of lint weight.

A laboratory analysis of a sample of X–78 as used in 1966 showed it to be a cationic surface active agent of the alkyl imidazoline class. It contains a long hydrocarbon chain derived from animal fat and has been converted to an ionic salt by reaction with ethyl sulfate. It is commonly used as a household and general-purpose textile softener. The product as compounded contained about 2 percent solids, and the level of application (0.15 percent) represented a solid 'add-on' to the cotton of approximately 0.003 percent. Trace quantities of X–78 on raw cotton can be detected readily by the method developed by Perkins.[2]

TEXAS EXPERIMENT, 1966

An experiment was conducted at Sebastian, Tex., in 1966 to determine the effects of the additive X–78 on gin operation and on the properties of the ginned lint. The manufacturer of the additive furnished the equipment for applying it and also supervised its installation and operation.

Experimental Procedure

On August 1, 1966, between 9 a.m. and 6 p.m., approximately 30 bales of cotton were harvested for the experiment from a 160-acre field in the Lower Rio Grande Valley. Two trailers of cotton were selected arbitrarily at the gin for the "without X–78" treatment and two trailers for the "with X–78" treatment. Five bales were ginned for each treatment. The overall experimental plan is shown in figure 1.

The privately owned gin was operated at 10 bales per hour as required for machine-picked cotton. Once the experiment was begun, no adjustments were made to the ginning system except to activate the X–78 pumping device after the set of five "without X–78" bales had been ginned.

The sequence and quantity of gin machinery used in this experiment were as follows:

(1) Bulk-feed controller.
(2) Tower drier.
(3) Ground harvester extractor.
(4) 6-cylinder cleaner.

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[1] Research physicist, Agricultural Research Service; agricultural economist, Economic Research Service; and chemist, Agricultural Research Service; respectively.

[2] PERKINS, H. H., Jr. DETECTION OF CATIONIC ADDITIVES ON COTTON. Textile Indus. 133 (5): 148-151. 1969.

(5) Tower driers—two in split stream.
(6) 7-cylinder cleaners—two in split stream.
(7) Stick extractors—two in split stream.
(8) Conveyor-distributor with X–78 applicator nozzle.
(9) Extractor feeders.
(10) Gin stands.
(11) Lint cleaners—two in split stream.
(12) Lint cleaners—two in split stream.
(13) Baling press.

A few samples of cotton were collected in polyethylene bags for laboratory moisture determinations 3 days later. Fiber moisture observations were made with an electronic-type moisture meter. No other data were collected during harvesting or ginning.

At the Department's Market Quality Research Division laboratory at Clemson, S.C., samples were taken from the 10 bales for classifying and for fiber tests, including fiber-length array, fibrograph, Pressley strength, micronaire, color, and foreign-matter content. However, cotton from only three untreated and three treated bales was processed into yarn. The cotton was spun into 40s yarn at a spindle speed of 13,000 r.p.m. One sample of untreated and one sample of treated cotton were spun simultaneously on the same frame by assigning alternate sets of six spindles to each treatment. The amount of cotton processed required about 7,000 spindle hours per sample.

Ends down were recorded for each 15-minute period of spinning, and lapped ends on rollers were recorded. At the end of each full doff, all ends were broken, the spinning frame was run for 15 minutes, and lapped ends were recorded. Samples of yarn were collected for tests of strength, appearance, and imperfections.

Six samples of filling yarn, three from cotton treated with X–78 and three from cotton without X–78, were woven using a common warp that contained no additive. The weave was a five-harness sateen, which gave a fabric face dominated by filling yarns. Three replications were woven. All the fabric was desized, scoured, and bleached together in a batch process. After bleaching, the replications were separated. Two replications were dyed with a direct blue dye—one a light shade and the other a heavy shade. A third replication was dyed with an acid dye.

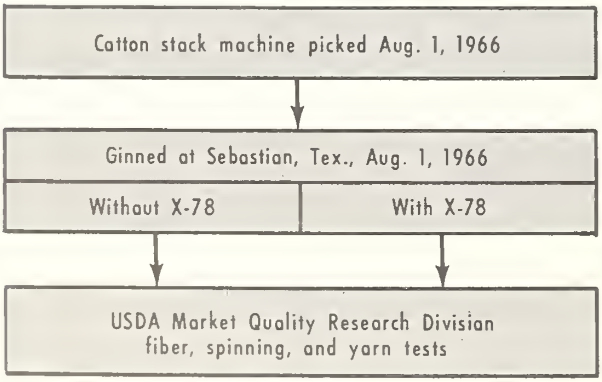

Cotton stock machine picked Aug. 1, 1966
Ginned at Sebastian, Tex., Aug. 1, 1966
Without X-78
With X-78
USDA Market Quality Research Division
fiber, spinning, and yarn tests

FIGURE 1.—Outline of 1966 Texas experiment.

Results and Discussion

Generally, with the exception of foreign-matter content, there were no differences in fiber properties due to treatment, although there were a few statistically significant differences (table 1). Nearly all were typical of differences in moisture content at the time of ginning. Since the moisture determinations made at the gin were not of laboratory quality, these data are not considered as strong evidence in evaluating treatment differences. Because of the moisture problem, a similar dilemma exists with respect to the spinning and yarn data.

The results of the bleaching and dyeing tests were conclusive in that no differences were found between the cotton with X–78 and the cotton without it. The bleached fabrics were all a good white and no differences could be detected between treated and untreated samples. The dyed samples were all of uniform shade, and the lightfastness and washfastness of the dyes were identical.

In addition to the conventional bleaching and dyeing tests, a bench-top experiment was conducted in which X–78 was sprayed on raw cotton and dried. A concentration of X–78 ranging from 0.5 to 0.8 percent, which is three to five times the amount applied to the cotton in this study, was needed before differences in the dyeing characteristics of the cotton were noted. These differences were manifested in the added ability of the treated fiber to absorb and retain anionic dye molecules of both direct and acid dyes. The result was a darker than normal shade on the cotton.

When the X–78 was spotted on cotton fabric in relatively concentrated amounts, dark dye spots resulted when the fabric was dyed with either acid or direct dyes. Once X–78 had been dried on the fabric, alkaline scouring and peroxide bleaching would not remove it. Fabrics treated in this manner when dyed with either acid or direct dyes had dark spots in each area where X–78 was originally applied.

TABLE 1.—*Effects of applying X–78 to cotton at gins on fiber properties, spinning performance, and yarn properties, Texas experiment, 1966* [1]

Property		Without X–78	With X–78
Fiber data:			
Lint grade	designation	SLM[2]	SLM
Lint grade	index	94	94
Foreign matter	percent	3.6 a	2.5 b
Reflectance (Rd)[3]	do	74.7 a	76.5 b
Yellowness[3]	+b factor	9.5 a	9.3 b
Staple length	1/32 inch	34.0	33.6
2.5-percent span length	inches	1.09	1.07
50-percent span length	do	.50	.49
Upper quartile length	do	1.23	1.21
Mean length	do	.99	.98
Fibers shorter than ½ inch	percent	9.9 a	10.7 b
Bundle strength, 0-gage	1,000 p.s.i.	81 a	83 b
Bundle strength, ⅛-inch-gage	grams per tex	23.4 a	22.6 b
Spinning and yarn data:			
Picker and card waste	percent	4.1	3.8
Neps per 100 square inches card web	number	37	41
EDMSH,[4] corrected	do	61	54
Lapped ends, 6-hour test	do	6	7
Lapped ends, 15-minute test	do	20 a	29 b
Yarn break factor	units	1,889	1,897
Yarn appearance	index	78	77
Yarn strength (Uster)	grams	197.8	200.8
Yarn irregularity (Uster), C.V.[5]	percent	22.7	22.4

[1] Average of 5 replications for fiber data and 3 for spinning and yarn data. Only values followed by different letters are significantly different at 5-percent level.

[2] SLM = Strict Low Middling.

[3] Lint cleaned by Shirley Analyzer.

[4] Ends down per 1,000 spindle hours.

[5] Coefficient of variability.

MISSISSIPPI EXPERIMENT, 1966

An additional experiment was conducted in 1966 at the Department's Cotton Ginning Research Laboratory at Stoneville, Miss., as a backup study to the earlier 1966 Texas experiment, with better experimental control so that more meaningful conclusions could be reached.

This experiment was designed to provide two levels of fiber moisture and two levels of lint cleaning on cotton processed without and with X–78 applied at 0.15 percent during ginning (fig. 2). Each treatment was replicated three times.

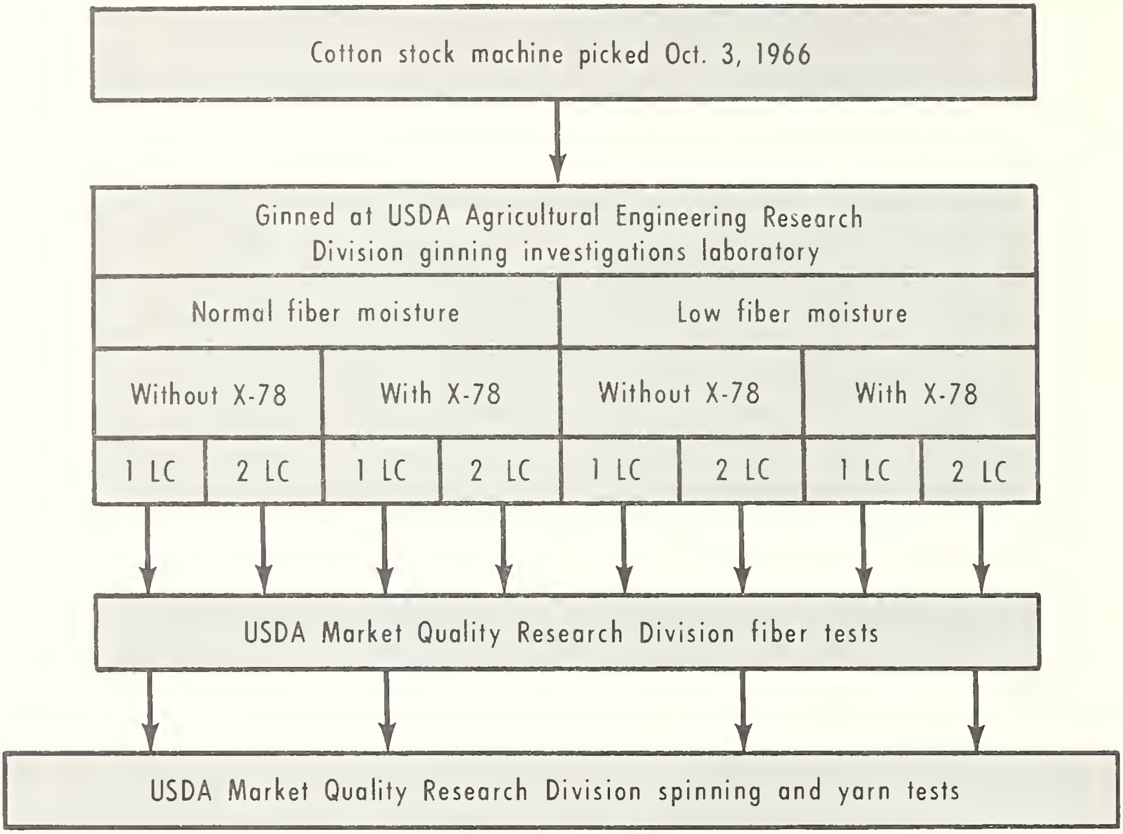
Experimental Procedure

Cotton for this experiment was spindle picked on October 3, 1966, and was ginned during the next 3 days in a full-size research ginnery. The gin machinery was typical of that required to handle Midsouth cotton. The sequence and quantity of machinery used in this experiment were as follows:

(1) Bulk-feed controller.
(2) Tower drier.
(3) 6-cylinder cleaner.
(4) Stick and green-leaf machine.
(5) Tower drier.
(6) 6-cylinder cleaner.
(7) Conveyor-distributor with X–78 applicator nozzle.
(8) Extractor feeder.
(9) Gin stand.
(10) First-stage saw–cylinder lint cleaner.
(11) Second-stage saw–cylinder lint cleaner.
(12) Baling press.

As with the Texas cotton, the experimental bales were shipped to the Department's Market Quality Research Division laboratory at Clemson, S.C., for fiber, spinning, and yarn tests. Samples from all bales were subjected to fiber tests, but spinning and yarn tests were made on selected bales only.

The experiment was analyzed by grouping the data into three categories, each containing two variations. Comparisons were made for fiber properties on 12 lots each (1) without versus with X–78, (2) high versus low fiber moisture at ginning, and (3) one stage versus two stages of saw-cylinder lint cleaning. Pro-


Cotton stock machine picked Oct. 3, 1966
Ginned at USDA Agricultural Engineering Research Division ginning investigations laboratory
Normal fiber moisture
Low fiber moisture
Without X-78
With X-78
Without X-78
With X-78
1 LC
2 LC
1 LC
2 LC
1 LC
2 LC
1 LC
2 LC
USDA Market Quality Research Division fiber tests
USDA Market Quality Research Division spinning and yarn tests

LC=lint cleaning.

FIGURE 2.—Outline of 1966 Mississippi experiment.

cessing and yarn properties were evaluated on six lots, each without and with X–78, except for lapped ends where only three lots each were recorded.

Results and Discussion

Comparisons of the fiber properties using unadjusted data showed that only for lint grade index was there a significant difference due to X–78 treatment (table 2). When these data were analyzed by covariance analysis to remove the effect of moisture, this difference disappeared leaving no significant differences among the various measured fiber properties due to applying X–78 during ginning.[3]

Among the mill-processing and yarn properties compared, picker and card waste showed a slight decrease due to using X–78 and yarn appearance a slight increase (table 3).

Differences in the amount of moisture in the fibers at ginning caused highly significant differences in lint grade, foreign-matter content, all fiber-length parameters, and ⅛-inch-gage bundle strength (table 2).

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[3] LAFERNEY, P. E., PERKINS, H. H., JR., and GRIFFIN, A. C. EFFECTS OF APPLYING A CHEMICAL ADDITIVE TO COTTON DURING GINNING. Cotton Mktg. Conf. Proc. 1967, pp. 15, 16. 1967.

TABLE 2.—*Effects of X–78, fiber moisture, and lint-cleaning treatments on selected cotton fiber properties, Mississippi experiment, 1966* [1]

Property		X–78		Fiber moisture		Number of lint cleanings	
		Without	With	High	Low	1	2
Fiber moisture [2]	percent	5.3	4.0	6.6 a	2.7 b	4.9	4.4
Lint grade	designation	SLM [3]	SLM	LM+ [3]	SLM+	SLM	SLM+
Lint grade	index	93.3 a	94.6 b	91.6 a	96.4 b	92.2 a	95.8 b
Foreign matter	percent	3.8	3.3	4.6 a	2.6 b	4.5 a	2.6 b
Reflectance (Rd) [4]	do	75.3	75.0	75.2	75.1	75.1	75.3
Yellowness [4]	+b factor	8.9	9.0	9.1	8.8	8.9	9.0
Staple length	1/32 inch	34.2	33.9	34.6 a	33.4 b	34.3	33.8
2.5-percent span length	inches	1.14	1.14	1.15 a	1.12 b	1.14	1.14
50-percent span length	do	.53	.51	.53 a	.51 b	.53	.51
Bundle strength, 0-gage	1,000 p.s.i.	83	83	83	83	83	83
Bundle strength, ⅛-inch-gage.	grams per tex	23.0	22.8	23.4 a	23.3 b	22.8	22.9

[1] Data based on average observations for 12 lots of cotton. Only values followed by different letters in same category are significantly different at 1-percent level, except grade indices in X–78 category, which are different at 5-percent level.

[2] At ginning.

[3] SLM = Strict Low Middling and LM = Low Middling.

[4] Lint cleaned by Shirley Analyzer.

TABLE 3.—*Effects of various cotton treatments on fiber moisture and selected processing items, Mississippi experiment, 1966* [1]

Property		X–78		High moisture plus 1 lint cleaning	Low moisture plus 2 lint cleanings
		Without	With		
Fiber moisture [2]	percent	4.9	4.1	6.6 a	2.3 b
Picker and card waste	do	4.4 a	4.0 b	5.9 a	2.5 b
Neps per 100 square inches card web.	number	10	9	7 a	12 b
EDMSH [3]	do	58	54	24 a	88 b
Lapped ends, 6-hour test	do	3	3	(4)	(4)
Lapped ends, 30-minute test	do	28	24	(4)	(4)
Yarn break factor	units	1,930	1,933	2,046 a	1,817 b
Yarn appearance	index	94 a	97 b	98 a	94 b
Yarn strength (Uster)	grams	190	193	193	190
Yarn elnogation (Uster)	percent	5.8	5.8	5.6 a	6.0 b

[1] Data based on average observations for 6 lots, except for lapped ends, which are based on average observations for 3 lots. Values followed by different letters in the same category only are significantly different at 1-percent level.

[2] At ginning.

[3] Ends down per 1,000 spindle hours.

[4] No comparison because lapped ends were not recorded for cotton ginned at high moisture plus 1 lint cleaning.

Two lint cleanings increased the lint grade compared to one lint cleaning by reducing the foreign-matter content (table 2).

The most obvious conclusion drawn from this experiment was that variations in fiber moisture content at ginning and amount of lint cleaning affect raw cotton properties, spinning performance, and yarn properties far more than using X–78 at 0.15 percent of lint weight.

Observations made while ginning the low moisture cotton showed that batting and lint flow characteristics improved considerably when X–78 was added to the cotton. Although quantitative measurements were not made, the improvement in batting and lint flow indicated that X–78 may be of some value as an antistatic agent where static electricity interferes with ginning.

MISSISSIPPI EXPERIMENT, 1967

Results of the 1966 experiments using Texas and Mississippi cottons showed no effects—either harmful or beneficial—directly attributable to the use of Protect-O-Coat Formula X–78 in quantities recommended by the manufacturer. Considering the possibility that X–78 might be used in quantities greater than those recommended by the manufacturer, an experiment was designed in 1967 to investigate the characteristics and processing performance of cotton ginned with X–78 applied at three rates. The experimental design also included adding moisture to the cotton concurrently with ginning, and it provided for ginning at two fiber moisture levels (fig. 3).

Besides the effects that X–78 might have on cotton, the effects of X–78 on controlling static electricity and on the amount of power required by the gin stand were also investigated.

Experimental Procedure

Two ginning series were planned to provide data for evaluating gin operation, fiber quality, and spinning performance. Twelve experimental lots were ginned immediately after harvest and enough cotton was stored to provide 12 additional lots to be ginned about 5 weeks later. While in storage the seed cotton underwent spontaneous heating, which was probably triggered by trapped moisture condensing on the storage bin walls and floor.

For each of the two ginning series the following six treatments were applied to both undried and dried cotton: No additive, water spray, water vapor, X–78 low rate, X–78 double rate, and X–78 maximum rate.

Actual additive rates (percent) based on the X–78 pump-delivery and gin-processing rates for cotton ginned immediately were as follows: Water spray 0.18, X–78 low rate 0.17, X–78 double rate 0.36, and X–78 maximum rate 0.59. Additive rates (percent) for stored cotton were as follows: Water spray 0.16, X–78 low rate 0.14, X–78 double rate 0.31, and X–78 maximum rate 0.51.

The gin machinery was typical of that used for Midsouth machine-picked cotton. The sequence and quantity of machinery used in this experiment were as follows:

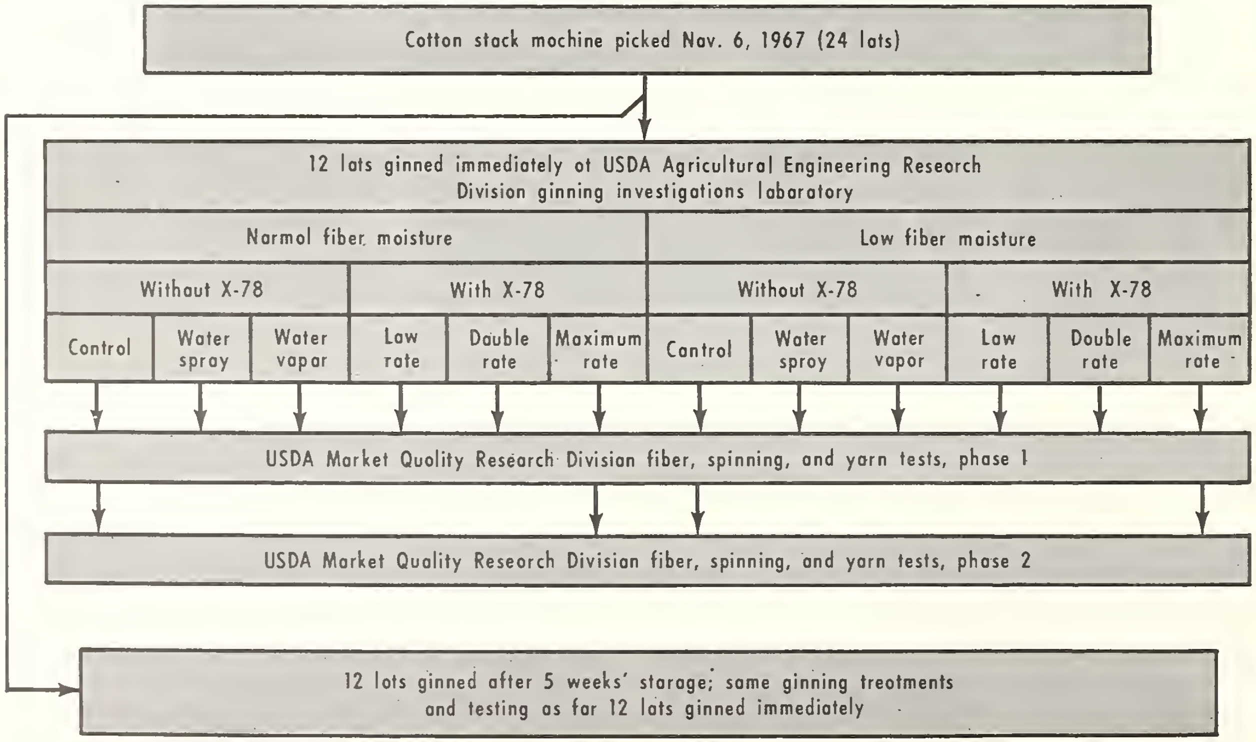
Cotton stock machine picked Nov. 6, 1967 (24 lots)
12 lots ginned immediately at USDA Agricultural Engineering Research Division ginning investigations laboratory
Normal fiber moisture
Low fiber moisture
Without X-78
With X-78
Without X-78
With X-78
Control
Water spray
Water vapor
Low rate
Double rate
Maximum rate
Control
Water spray
Water vapor
Low rate
Double rate
Maximum rate
USDA Market Quality Research Division fiber, spinning, and yarn tests, phase 1
USDA Market Quality Research Division fiber, spinning, and yarn tests, phase 2
12 lots ginned after 5 weeks' storage; same ginning treatments and testing as for 12 lots ginned immediately

FIGURE 3.—Outline of 1967 Mississippi experiment.

(1) Bulk-feed controller.
(2) Tower drier.
(3) 6-cylinder cleaner.
(4) Stick and green-leaf machine.
(5) Tower drier.
(6) 6-cylinder cleaner.
(7) Conveyor-distributor with X–78 applicator nozzle.
(8) Vapor chute.
(9) Extractor feeder.
(10) Gin stand.
(11) First-stage saw-cylinder lint cleaner.
(12) Second-stage saw-cylinder lint cleaner.
(13) Baling press.

Random replication of the treatments was not done because of the contaminating effect that X–78 residue might have on the machinery and thereby render the experiment invalid for the established objective. Within each series of ginned immediately and ginned after storage, all lots without X–78 were processed before the lots with X–78.

During ginning, measurements were made with a recording wattmeter of the power required by the motor that pulled the gin stand and feeder to determine whether any of the treatments caused a significant change in the amount of energy required for ginning.

Also, static electricity was measured on cotton at the lint slide to determine the relative effects of the treatment on the production of static electricity during ginning.

The ginned lint was sent to the Department's Market Quality Research Division laboratory at Clemson, S.C., for fiber, spinning, and yarn tests, including dyeability with direct dyes.

The 24 lots were spun in a small-scale spinning test (phase 1) on a screening basis to detect any obvious differences in spinning performance and yarn properties. Yarns from the freshly harvested cotton were woven into fabrics for dyeing tests using direct dyes.

In a final series of fiber and full-scale spinning tests (phase 2), where the effects of adding X–78 to cotton at the maximum rate could be compared directly to cotton without X–78, eight lots of cotton were used, two each for the following four tests: Ginned immediately undried, ginned immediately dried, stored undried, and stored dried.

Results and Discussion

The test results are given in tables 4–6. Generally the different quantities of X–78 added to cotton seemed to make little, if any, difference in the various properties measured.

Lint Grade.—This experiment presents an excellent opportunity to observe the effects of seed-cotton treatments on lint foreign-matter content, color and reflectance, and composite grade classification. The grade indices for both the without and with X–78 treatments averaged 91, which is about Low Middling plus or Strict Low Middling Light Spot. The similarity in fiber moisture, foreign matter, yellowness, and reflectance for both the without and with X–78 treatments support the similarity in lint grade.

The dried lots gave higher lint grade classifications than the undried lots (92 versus 89), because they contained less foreign matter (2.8 versus 4.1 percent), with only slight differences in yellowness and reflectance.

The cotton ginned immediately after harvesting had a lint grade index of 94 and the stored cotton only 88. Here the difference was principally due to yellowness and reflectance aided perhaps by slightly less foreign matter in the cotton ginned immediately. Because of the spontaneous heating, the stored cotton suffered fiber staining as a natural result of seed spoilage and possibly some bacteriological and fungus damage.

Staple Length.—Neither X–78 treatments nor storage treatments affected the staple length assigned by the cotton classer. The lots that were gin dried to low moisture were classed one staple length shorter than the undried lots (1-3/32 versus 1-1/16 inches).

2.5- and 50-Percent Span Length.—There were no significant differences in span length in any of the three major categories that could not be attributed to differences in moisture content. Whether X–78 was or was not added to cotton had no effect on fiber span length as measured by the Digital Fibrograph.

1/8-Inch-Gage Bundle Strength.—The modal fiber-bundle strength was about 22 grams per tex. Only the drying treatment variable caused a significant difference in fiber-bundle strength. It must be pointed out that the severe drying treatments in this experiment were for research purposes, and drying to the low moisture levels of this experiment cannot be recommended for commercial gin operation.

Yarn Break Factor and Single-Strand Yarn Strength.—Variations in yarn strength determinations were related more to fiber moisture content at ginning and the resulting span lengths than to whether the cotton received X–78 or whether it was stored.

Yarn Appearance, Irregularity, and Neps.—Determination of yarn appearance, irregularity, and neps followed similar patterns with respect to ginning treatments and moisture

TABLE 4.—*Effects of various cotton treatments on selected ginning, quality, and processing items, Mississippi experiment, 1967*[1]

Item	X–78		Ginned			
	Without	With	Undried	Dried	Immediately	After storage
Ginning data:						
Fiber moisture ... percent	5.7	5.2	7.2 a	3.8 b	4.7 a	6.2 b
Energy consumption[2] ... kilowatt-hours per bale	5.90	5.90	5.88	5.92	5.94	5.86
Fiber data:						
Lint grade ... index	91	91	89	92	94 a	88 b
Foreign matter ... percent	3.5	3.4	4.1 a	2.8 b	3.3 a	3.7 b
Reflectance (Rd)[3] ... do	74.8	74.6	74.8	74.7	77.9 a	71.6 b
Yellowness[3] ... +b factor	9.2	9.3	9.1 a	9.4 b	8.1 a	10.4 b
Staple length ... 1/32 inch	35	35	35 a	34 b	35	35
2.5-percent span length ... inches	1.11	1.10	1.12 a	1.09 b	1.10 a	1.11 b
50-percent span length ... do	.47	.47	.49 a	.46 b	.46 a	.48 b
Bundle strength, ⅛-inch-gage ... grams per tex	21.6	22.0	22.1 a	21.5 b	22.0	21.7
Spinning and yarn data (phase 1):						
Lapped ends, 15-minute test ... number	2.0	1.4	2.0	1.4	1.4	2.0
Lapped ends, 294-spindle hour test ... do	.4	.2	.2	.5	.6	.1
Yarn break factor ... units	1,788	1,808	1,884 a	1,712 b	1,750 a	1,846 b
Yarn appearance ... index	75	75	77 a	74 b	74 a	77 b
Yarn strength (Uster) ... grams	184	182	194 a	171 b	180	185
Yarn irregularity, C.V.[4] ... percent	23.9	24.0	23.0 a	24.8 b	24.2 a	23.7 b
Neps per 1,000 yards ... number	1,322	1,304	1,190 a	1,436 b	1,333	1,293

[1] Data based on average observations for 12 lots. Only values followed by different letters in same category are significantly different at 5-percent level.
[2] Gin stand plus feeder.
[3] Lint cleaned by Shirley Analyzer.
[4] Coefficient of variability.

TABLE 5.—*Effects of additive treatments and fiber moisture on presence of static electricity on cotton at lint slide, Mississippi experiment, 1967*[1]

Treatment	Fiber moisture	Static electricity
	Percent	*Arbitrary units*
Ginned undried:		
No additive	8.2	0.07
Water spray, 0.16 percent	8.2	.08
Water vapor	7.1	.16
X–78:		
0.14 percent	6.7	.20
0.31 percent	6.8	.21
0.51 percent	6.7	.18
Ginned dried:		
No additive	3.9	.58
Water spray, 0.16 percent	4.4	.57
Water vapor	4.1	.58
X–78:		
0.14 percent	3.8	.33
0.31 percent	4.0	.53
0.51 percent	3.7	.42

[1] Cotton stored 5 weeks before ginning.

content. Again fiber length was found to be an indicator for yarn appearance and irregularity. Fiber with the longer span length produced better looking yarn than that with the shorter span length.

Lapped Ends.—Both the 15-minute test and the 294-spindle hour test failed to show significant differences due to ginning treatments whether in the X–78 additive, drying, or storage categories.

Energy Consumption.—One of the objectives of the experiment was to determine whether using X–78 on cotton would reduce the electric load on the gin-stand motor by reducing seed roll to roll box friction. The data reported represent the total amount of energy required by the electric motor that powered the gin stand and its feeder during the ginning of each experimental lot. All data were adjusted to a constant bale weight of 479 pounds of lint. These data showed that neither X–78 nor gin drying nor seed-cotton storage caused significant differences in the amount of power required to operate the gin stand and its associated feeder.

The average power required to operate the gin and feeder was 5.901 kilowatt-hours per bale. When the average power required to run the gin stand and feeder without cotton (idling power) was subtracted from the total power, the average power required to feed cotton and separate the fibers from their seeds was 1.374 kilowatt-hours per bale. Although not statistically significant at the 95-percent confidence level, the cotton ginned after storage required less power for fiber-seed separation than the cotton ginned immediately.

Static Electricity.—It is believed that X–78 was originally used in cotton gins as an antistatic agent. This experiment included provisions for comparing the difference in static electricity levels on cotton at the lint slide of the ginnery. The instrumentation used when ginning the freshly harvested cotton did not produce satisfactory information. A different type of electrode was used when ginning the stored cotton. The data extracted from the system were not in absolute units (volts) but were relative to one another.

The instrumentation was not changed during ginning so that the detected changes in potential magnitudes are due only to changes in static electricity on the cotton. It is noted that for the cotton without X–78, the static level increased as the fiber moisture content decreased (table 5). The correlation coefficient between static electric potential and fiber moisture content was −0.995, indicating a very close relationship between these two items. When similar data were examined for the cotton receiving X–78, the correlation coefficient was only −0.887. When these data were plotted, the static electricity level of treated lots in the low moisture range (about 4 percent) was below that expected based on observations from the untreated lots (fig. 4 and table 5). This meager amount of data suggests that X–78 does abate

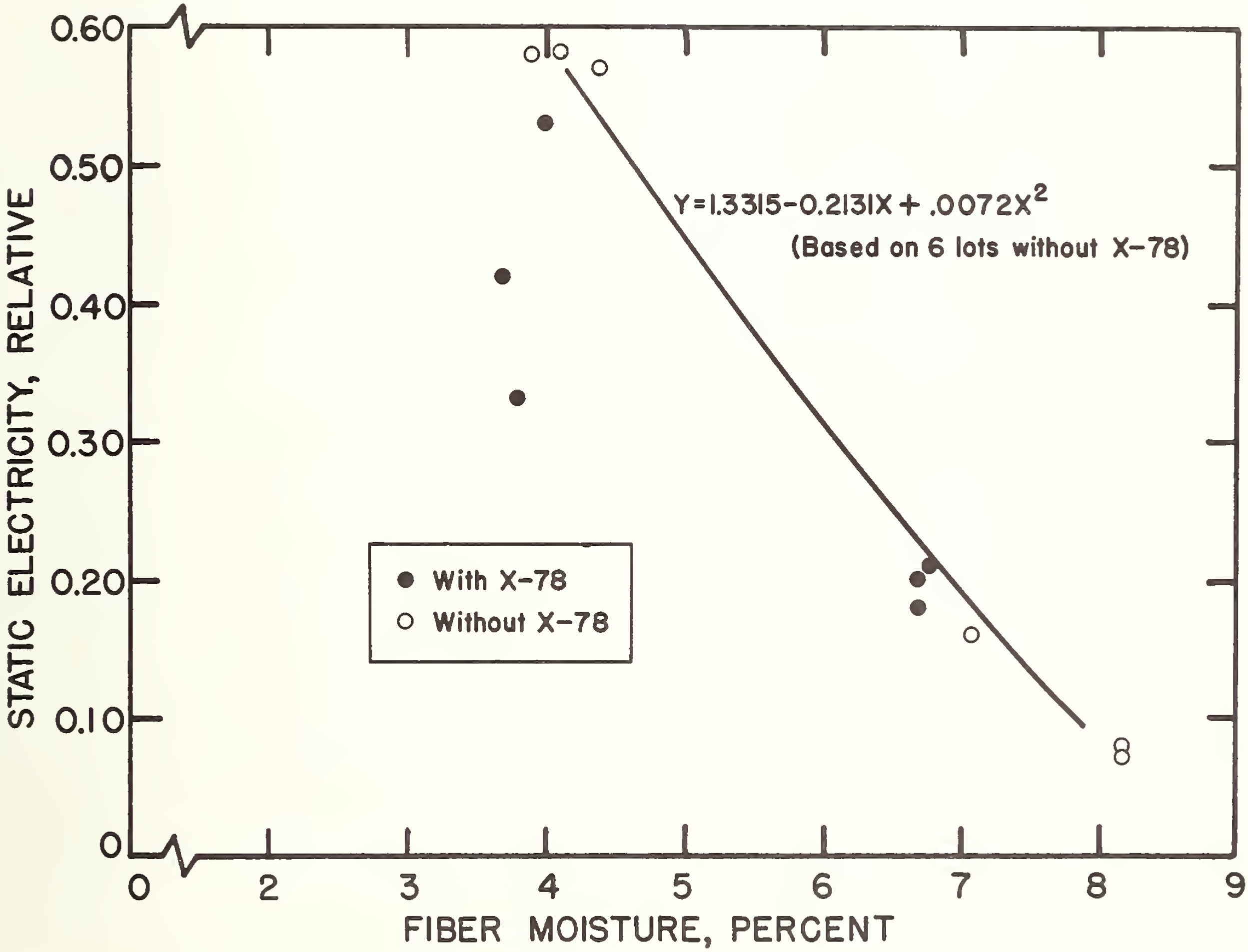

FIGURE 4.—Effect of fiber moisture and X–78 on static electricity on cotton at lint slide, 1967 Mississippi experiment.

TABLE 6.—*Effects of X–78 applied at maximum rate to cotton ginned undried and dried on selected quality and processing items, Mississippi experiment, 1967* [1]

Item	Ginned undried		Ginned dried	
	No X–78	X–78 maximum rate	No X–78	X–78 maximum rate
Fiber data:				
Colorimeter lint grade ....index	88	88	96	94
Foreign matter ....percent	2.8	3.2	2.2	2.4
2.5-percent span length ....inches	1.11	1.12	1.08	1.07
50/2.5 uniformity ratio ....percent	45	45	43	43
Bundle strength, ⅛-inch-gage ....grams per tex	21.3	22.3	21.2	20.8
Spinning and yarn data (phase 2):				
Picker and card waste ....percent	4.7	5.0	4.1	4.3
EDMSH [2] ....number	32	40	84	87
Yarn break factor ....units	1,802	1,801	1,660	1,688
Yarn irregularity C.V.[3] ....percent	22.4	22.9	24.4	24.4

[1] Data based on average for 1 bale ginned immediately and 1 bale ginned after storage.

[2] Ends down per 1,000 spindle hours.

[3] Coefficient of variability.

to some extent static electricity on cotton to which X–78 was added at between 0.14 and 0.15 percent.

Dyeing Behavior.—No differences in dyeing existed between samples with X–78 and those without it. However, the samples from cotton gin dried to about 4-percent moisture content dyed lighter than the undried ones. The presence or absence of X–78 on the sample did not affect this result.

Maximum Rate of X–78 Compared With No X–78 (Full-Scale Spinning, Phase 2).—To compare the properties of the cotton containing the maximum amount of X–78 and the cotton containing no X–78, the data for cotton ginned immediately were combined with data from stored cotton for presentation in table 6. None of these data show significant differences attributable to the X–78 treatments. Even though the chances of trouble caused by static electricity under low moisture conditions are apparently lessened to some extent when X–78 is present, the properties of the cotton are not preserved. Proper moisture content is necessary if the desirable properties of cotton are to be retained.

SUMMARY

Two experiments using X–78 as a chemical additive applied to cotton during ginning were conducted in 1966 and one was conducted in 1967. The objectives were to evaluate the effects of X–78 on gin processing and on fiber, spinning, and dyeing qualities of cotton. Experimental variables included (1) ginning cotton without and with X–78, (2) using X–78 at the rate recommended by the manufacturer and at double and more than triple that rate, (3) ginning cotton without drying and with severe drying, and (4) ginning cotton immediately and with 5 weeks' delay after harvesting.

These experiments showed that when Protect-O-Coat Formula X–78 was added to cotton at the rate recommended by the manufacturer, with the exception of some abatement of static electricity in low moisture cotton, no improvements in cotton quality or in either gin processing or spinning-mill processing could be found. Neither did these experiments show harmful effects on cotton quality or on processing operations. The antistatic effect was observed primarily at moisture levels well below those recommended for ginning, but did not protect inherent fiber properties. No improvement in grade could be found that was attributable to the use of X–78. Any improvement in grade occurred with low moisture ginning, which resulted in poorer fiber and yarn quality. Also, drying to a moisture level of about 4 percent resulted in a lighter shade of dyed yarn than did higher moisture levels. The use of X–78 did not change this relationship.

Since using X–78 did not overcome fiber- and spinning-quality problems associated with ginning at low fiber moisture levels, and even though static electricity was reduced, the ginner must rely on maintaining fiber moisture content during the ginning process to control the quality of cotton produced. Proper moisture content during ginning was the most important factor in preserving cotton quality and in controlling static electricity.

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